



Air-sea exchange of nitrogen and carbon over the Northwest-European Continental Shelf

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The ecosystem model ECOHAM3 we developed simulates the marine carbon, nitrogen and oxygen cycle. We used the model to evaluate especially the fluxes between the shelf and the atmosphere, i.e. the absorption and release of CO₂, the aeolian input of bioavailable nitrogen compounds and the release of molecular nitrogen due to benthic denitrification. The simulations were performed for the mid-nineties, a period with an extremely large variation of the NAO index with the consequence of very different meteorological conditions. Time series of daily riverine nitrogen and carbon loads were used, while for the atmospheric deposition of nitrate and ammonium only annual means from EMEP (European Monitoring and Evaluation Program) were available.

According to our model results the Northwest European Shelf acts as a 'continental shelf pump', i.e. it effectively absorbs atmospheric CO₂ (300 Gmol C yr⁻¹ in the high-NAOI years 1994/95 and 560 Gmol C yr⁻¹ in 1996 with the very low NAOI) and exports dissolved inorganic carbon into the neighbouring open North Atlantic. At the same time the shelf, especially the North Sea, gets a large amount of nitrogen via atmospheric deposition (27 Gmol N yr⁻¹) as well as by river input (50-80 Gmol N yr⁻¹) which is biologically used. A large part of the nitrogen the North Sea is supplied

with, including a considerable advective net inflow of organic nitrogen, is released to the atmosphere as molecular nitrogen (about $70 \text{ Gmol N yr}^{-1}$). In spite of this strong benthic denitrification the North Sea acts as net source of dissolved inorganic nitrogen for the North Atlantic; this is a consequence of the net heterotrophy of the North Sea.